Control Number
DVEML0263

MODEL 1700 Series

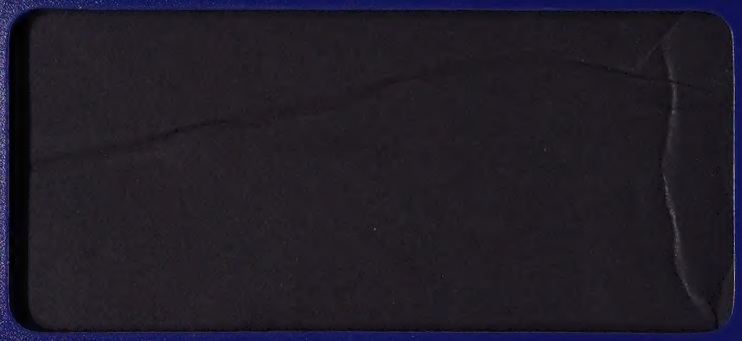
Digital Resistance Measuring System

Instruction Manual

Part Number 21400 May 1980

MP MASTER
MA29636

esi® Manual



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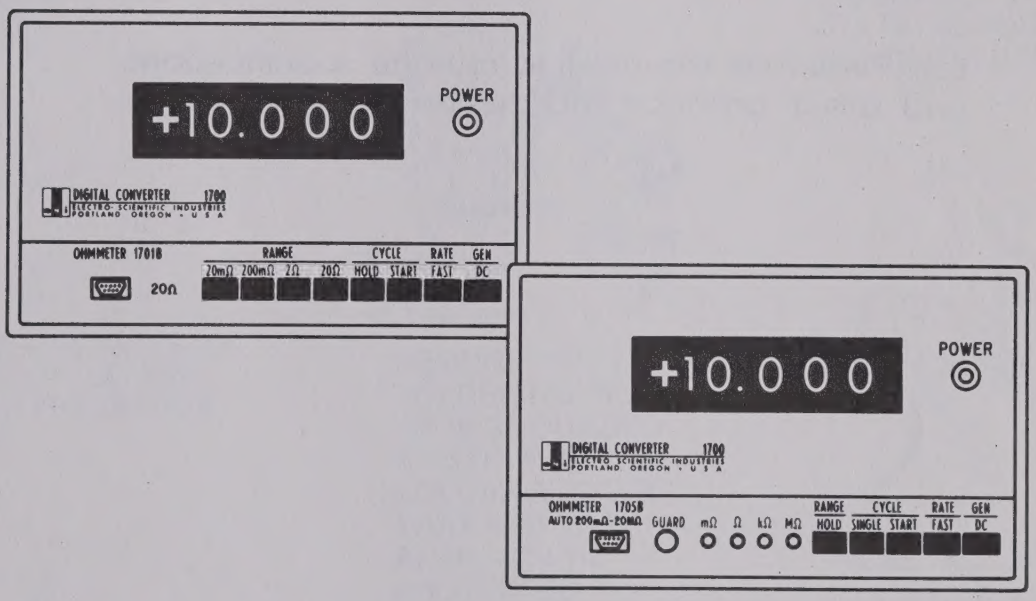

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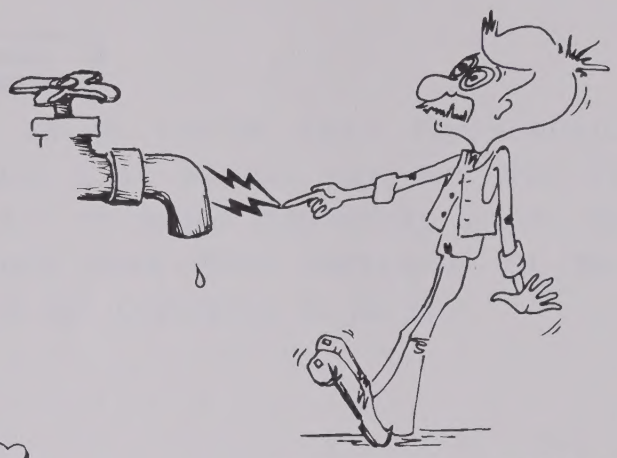

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HANDLE DEVICES BY THE BODY. DO NOT TOUCH THE DEVICE LEADS.

BE SURE YOUR SOLDERING IRON TIP IS GROUNDED AND DO NOT USE SOLDER-SUCKERS THAT ARE NOT ANTI—STATIC PROTECTED

AVOID HANDLING WHENEVER POSSIBLE

USE ANTI-STATIC PACKAGING FOR HANDLING AND TRANSPORT

KEEP PARTS IN MANUFACTURER'S PROTECTED CONTAINERS

DO NOT SLIDE STATIC SENSITIVE DEVICES OVER ANY SURFACE AND AVOID PLASTIC, VINYL AND STYROFOAM IN WORK AREAS

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WARNING

DANGEROUS VOLTAGE POTENTIALS EXIST INSIDE THIS INSTRUMENT. MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT ATTEMPT ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATION INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

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SECTION 1
DESCRIPTION

1.1 INTRODUCTION

The Model 1700 is a family of compact ohmmeters. It consists of the Model 1700 Digital Converter and a selected preamplifier subassembly. The system makes four-terminal resistance measurements rapidly (2 to 13 measurements per second) and accurately (0.02% basic) and shows the results on a 4-1/2 digit LED display.

Two plug-in preamplifiers are available. The Model 1701B Preamplifier covers the low end of the resistance spectrum with full-scale ranges of 20mΩ, 200mΩ, 2Ω and 20Ω. The Model 1705B Preamplifier is an auto-ranging unit covering nine ranges, the lowest and highest ranges being 200mΩ and 20MΩ respectively.

For systems applications the unit may be started or stopped, operated in single or continuous measurement mode and measurement results read out through buffered BCD outputs using the remote input/output connector. This feature allows the instrument to be mated to a companion instrument such as the Model 1715 Comparator or to automatic parts handling equipment.

1.1.1 Measuring Techniques

When choosing the appropriate plug-in Ohmmeter Preamplifier, consideration should be given as to what measuring technique would best satisfy the user's requirements. Two test modes are provided: continuous measurement or single measurement. Also available are three different test signals: switched DC, constant DC or (1705B only) single pulsed DC. Measurements are made using dual-slope integration. See Section 2 for additional details.

1.1.2 Model 1701B Plug-In Low Ohmmeter Preamplifier

Model 1701B plug-in is primarily designed for high accuracy measurements in the low resistance regions, 1μΩ to 20Ω. It is generally used for measuring the resistance of wires, circuit board connector strips, switch contacts, relay contacts, connectors, transformer or motor windings, and other low ohm applications. This plug-in incorporates continuous measuring or single measurement modes and switched DC or constant DC test signals.

1.1.3 Model 1705B Plug-In Autoranging Ohmmeter Preamplifier

Model 1705B plug-in is primarily designed to measure an unknown resistance value from 10μΩ to 20MΩ, and automatically select the range providing the highest resolution display. This feature eliminates the need for manual range selection, thus saving time and avoiding operator errors. A range hold switch is provided to save time when a series of measurements, within a particular range, are to be made. Front panel LED lamps on the plug-in indicate what range mΩ, Ω, kΩ or MΩ is being displayed on the Model 1700. This plug-in incorporates continuous measuring or single measurement modes and switched DC, constant DC or single pulsed DC test signals. The single pulsed DC test signal is useful when measuring temperature sensitive devices (thermistors, etc.) since it limits the power (heating) to the unknown.

1.2 GENERAL SPECIFICATIONS: MODEL 1700 WITH PLUG-IN

Linearity Error: 0.01% maximum; 0.005% typical.

Measurement Rate: 2 to 13 measurements per second.

Measurement Mode: Continuous or single. Single measurement mode is initiated by a front panel pushbutton. Remote start and remote mode control is available by means of the output connector (J1).

Measurement Technique: Dual-slope integration, auto-zeroing, switched DC or constant DC or single pulsed DC (1705B only).

Measurement Display: 4-1/2 digit LED with decimal point. Blanked for overload conditions.

Range Display: Range being display by the LED readout is indicated by the range pushbutton on the 1701B and by front panel LED lamps on the 1705B.

AC Noise Rejection: 80dB at 60Hz and multiples (50Hz optional).

Connection to Unknown: Four-terminal, guarded, is provided by the supplied KELVIN KLIPS® Cable Assembly. (ESI Part Number 27838).

Outputs: A number of features are available from the rear connector (J1), including buffered BCD signal, remote start, etc.

Power Consumption: 36 watts typical.

Power Requirements: 105 to 125VAC or 210 to 250VAC, 60Hz.

Fuse Requirements: Ø.5A, fast-blo, 3AG at 115V; Ø.25A, fast-blo at 230V.

Size: Height (with feet) - 135mm (5.3 inches)
Width - 216mm (8.5 inches)
Depth (Overall) - 330mm (13 inches)

Weight: 5.4kg (12 lb) net.

Suggested Accessories: Model 1715 Digital Comparator for rapid LO, GO or HI sorting.

Model SP3779 very low ohm measurements, Ø.1μΩ to 200mΩ.

Model 1717 Four-Terminal Sorting Fixture.

Spade lug cable assembly (instead of clips) enables connection to binding posts of peripheral equipment, etc. (ESI Part Number 27867).

Four-terminal probes for low ohm resolution to check PC boards. (ESI Part Number 41938).

PC Extender Board. (ESI Part Number 27785).

Options: 50Hz operation.

1.3 INDIVIDUAL SPECIFICATIONS: MODEL 1700 WITH PLUG-IN

SPECIFICATIONS	MODEL 1701B				MODEL 1705B								
RANGES	20 mΩ	200 mΩ	2 Ω	20 Ω	200 mΩ	2 Ω	20 Ω	200 Ω	2 kΩ	20 kΩ	200 kΩ	2 MΩ	20 MΩ
RESOLUTION	1 μΩ	10 μΩ	100 μΩ	1 mΩ	10 μΩ	100 μΩ	1 mΩ	10 mΩ	100 mΩ	1 Ω	10 Ω	100 Ω	1 kΩ
ACCURACY SWITCHED DC	±(0.02% + 1 digit + 10 μΩ) ±(0.01% + 1 digit + 5 μΩ) typical				±(0.02% + 1 digit + 15 μΩ) ±(0.01% + 1 digit + 5 μΩ) typical							±(0.04% + 1 digit) ±(0.02% + 1 digit) typical	
ACCURACY PULSED DC① AND CONTINUOUS DC	±(0.02% + 1 digit + 10 μΩ) ±(0.01% + 1 digit + 5 μΩ) typical				±(0.04% + 1 digit + 100 μΩ) ±(0.02% + 1 digit + 50 μΩ) typical						④	②	②
REFERENCE CURRENT	100 mA				70 mA	70 mA	7 mA	4.5 mA	450 μA	450 μA	4.5 μA	4.5 μA	0.45 μA
OVERLOAD REFERENCE CURRENT③	150 mA for 100 μs (125 mA for 75 μs) typical				100 mA (15 V max thru 150 Ω)								
MAXIMUM LEAD RESISTANCE (in any or all leads with no error)	5 Ω	5 Ω	5 Ω	2.5 Ω	10 Ω	10 Ω	10 Ω	50 Ω	50 Ω	50 Ω	40 Ω	40 Ω	40 Ω
TEMPERATURE COEFFICIENT	≈20 ppm/°C from 15-35°C				≈5 ppm/°C from 15-35°C							≈8 ppm/°C from 15-35°C	

①Pulsed DC applies only to Model 1705B.
②2MΩ and 20MΩ not recommended for pulsed DC; 20MΩ not recommended for continous DC; due to internal settling times.
③Possible only during connection of measurement leads to unknown. Reference current is still specified for each range, if unknown causes overload.
④Slow rate only.

SECTION 2
OPERATION

2.1 MEASUREMENT TEST SIGNALS

a. Switched DC

b. Constant DC

c. Single pulsed DC

Figure 2-1. Measurement Test Signals Applied to the Unknown

2.1.1 Switched DC

Switched DC measurement test signal consists of alternating positive and negative square wave pulses. In this two step process, the test signal is reversed in polarity after the first measurement and a second measurement of the opposite polarity is made. These two measurements are then algebraically added to cancel thermoelectric voltage errors and offsets. The result is the value of the unknown.

Switched DC is applicable over the entire range. It is especially useful for measurement of non-inductive unknowns below 100Ω. In this low resistance region thermal offset voltages, resulting from heating effects of the test current, can approach a millivolt level that could be significant when compared to the unknown millivolt level.

2.1.2 Constant DC

Constant DC measurement test signal consists of a single polarity, fixed current. This process is used to eliminate errors from inductance effects, such that a settling time of 10 L/R second is unacceptable. This technique allows measurements of unknowns with

large inductive components, such as transformers and motors. Stray voltage offsets are not cancelled with this test signal. However, care in balancing external connections can help reduce offset voltages.

2.1.3 Single Pulsed DC

Single pulsed DC measurement test signal (Model 1705B only) consists of a single polarity pulse of DC current. This process is useful when measuring temperature sensitive resistances (such as thermistors) since it minimizes internal heating of the unknown. (Single pulse is also useful for applications requiring low voltage (50mV or less) test signals, such as measuring contact resistance.)

2.2 CONTROLS AND CONNECTORS

2.2.1 Model 1700 Digital Converter Front Panel

The only control on the front panel of the Model 1700 Digital Converter is the POWER switch. This push-on, push-off switch has an integral pilot lamp which lights when the power is on. See Figure 2-2.

2.2.2 Model 1701B Plug-In Low Ohmmeter Preamplifier

The Model 1701B Ohmmeter Preamplifier has four manually selectable ranges. See specifications. Figure 2-2 shows the system with the Model 1701B plug-in.

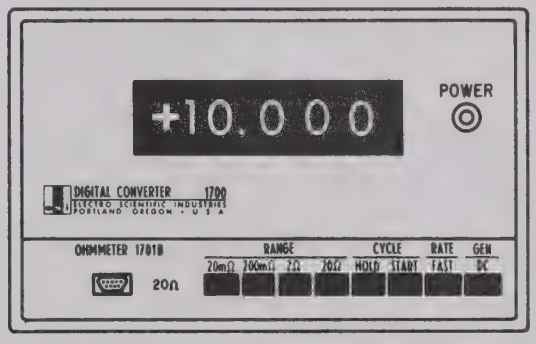


Figure 2-2. Typical 1700 Series Front Panel

2.2.2.1 Model 1701B Controls

GEN — When this push switch is in the DC position (pushed in), measurements are made with a constant DC current through the unknown, (Constant DC). When this push switch is in the out position (push to release), the measurements are made with alternating positive and negative square wave pulses, (Switched DC).

RATE — When this push switch is in the FAST position (pushed in), the measurement rate is approximately thirteen measurements per second. When this push switch is in the out position (push to release), the measurement rate is approximately two measurements per second.

CYCLE/HOLD — When this push switch is in the out position (push to release), the instrument makes continuous measurements at the rate selected, (fast or slow). When this push switch is in the HOLD position (pushed in), a single measurement is held until another measurement is initiated. NOTE: Test current to the unknown is not removed -- unknown resistance may change due to a heating effect.

CYCLE/START — This momentary push switch manually initiates (when pressed in) a single measurement cycle when the CYCLE push switch is in the HOLD position (pushed in). This momentary push switch also manually initiates (when pressed in) continuous measurements when the CYCLE push switch is in the out position (pushed to release).

RANGE — These four push switches select the desired full-scale range. They are interlocked so that only one can be pushed in at a time. If none of these push switches is pushed in, the 2 ohms range is automatically selected.

FRONT-PANEL CONNECTOR — Contains the terminals for the four leads to the unknown, plus a guard connection for the cable shield.

2.2.3 Model 1705B Plug-In Autoranging Ohmmeter Preamplifier

The Model 1705B Autoranging Ohmmeter Preamplifier has nine automatic selectable resistance ranges. See specifications. Figure 2-3 shows the Model 1705B plug-in.

Figure 2-3. Model 1705B Front Panel

2.2.3.1 Model 1705B Controls, Indicators and Connectors

AC/DC — When this push switch is in the DC position (pushed in), the measurements are made with a constant DC current through the unknown, (Constant DC). When this push switch is in the AC position (push to release), the measurements are made with alternating positive and negative square wave pulses, (Switched DC).

RATE — When this push switch is in the FAST position (pushed in), the measurement rate is approximately thirteen measurements per second. When this push switch is in the out position (push to release), the measurement rate is approximately two measurements per second.

CYCLE/SINGLE — When this push switch is in the out position (push to release), the instrument makes continuous measurements at the rate selected (fast or slow). When this push switch is in the SINGLE position (pushed in), a single measurement is held and the test current removed until another measurement is initiated. NOTE: When the push switch is in the SINGLE position, the RANGE/HOLD should be in the HOLD position to avoid autoranging.

CYCLE/START — This momentary push switch manually initiates (when pressed in) a single measurement (SINGLE PULSED DC) when the CYCLE/SINGLE push switch is in the SINGLE position (pushed in). This momentary push switch also manually initiates (when pressed in) continuous measurements when the CYCLE/SINGLE push switch is in the out position (pushed to release).

RANGE

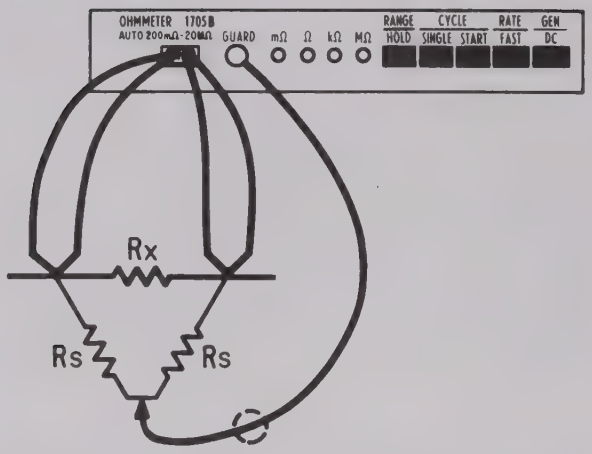
When this push switch is in the out position (push to release) the autoranging feature automatically selects the range giving the highest resolution. When this push switch is in the HOLD position (pushed in), the autoranging feature is disabled and the preamplifier stays in the range it had selected. This function saves time when a series of measurements within a particular range are to be made.

mΩ, Ω, kΩ, MΩ

These LED lamp indicators show the units being displayed.

GUARD

This banana jack permits connection to a guard, or shield. This is useful mainly on the top two ranges where the standard current is very low and could be affected by static charges or injected current from capacitive coupling to a body or machinery. The test leads provided already have a shield, and dual-slope integration provides a line frequency rejection ratio of 80dB. The guard is also used when making closed loop measurements. It serves to force the interconnect point of the resistors shunting the unknown to analog common. This reduces the shunting resistors to loads on the input and output of the unknown driver. This enables an accurate measurement even though two or more resistors are shunting the unknown resistor. See Figure 2-4 and note.



NOTE
SHUNTING RESISTORS Rs MUST BE NO SMALLER THAN THE VALUE SHOWN IN THE FOLLOWING TABLE:

RANGE	Rs
200kΩ, 2MΩ, 20MΩ	500kΩ
20kΩ	200kΩ
200Ω, 2kΩ	20kΩ
20Ω	3kΩ
2Ω	1.5kΩ
200mΩ	100Ω

Figure 2-4. Guarded Measurements

NOTE: When measuring the resistive component of high Q inductors, Model 1705B should only use the constant DC test signal.

2.2.4 Rear Panel

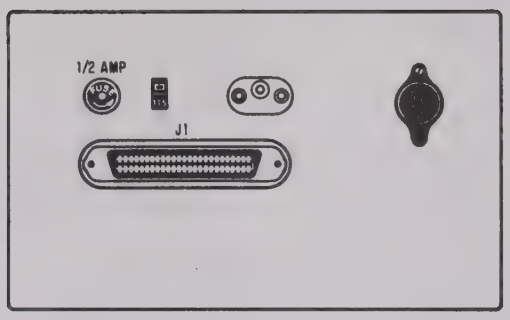


Figure 2-4. Model 1700 Rear Panel

FUSE	The power line fuse used is 0.5A, fast-blo type 3AG at 115V; 0.25A fast-blo at 230V.
115/230 SWITCH	Selects the nominal line voltage. See Section 4.4 to change power line frequency.
REMOTE INPUT/OUTPUT CONNECTOR J1	This connector allows the 1700 Series to be used with other equipment, such as the Model 1715 Comparator, and/or parts handling equipment. Refer to Table 2-2 for connector pin assignments. See Section 2.4 for remote operation.

2.3 GENERAL INSTRUCTIONS

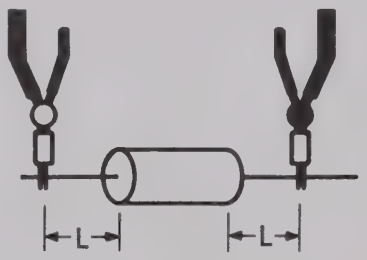
2.3.1 Applying Power

A front panel push-on, push-off switch turns power ON and OFF. When power is applied, the power switch's integral pilot lamp lights. To initialize the Model 1700's internal logic to the proper starting condition, push the START button on the preamplifier being used. The instrument is now ready to make measurements.

2.3.2 Making Measurements

The KELVIN KLIPS® Four-Terminal Clips supplied or the optional sorting fixture, insures accuracy by making four-terminal connections to the resistor being measured. The cable set or sorting fixture plugs into the preamplifier front panel connector; although this connector type does not provide a rigid mechanical connection, a good electrical connection is maintained.

> NOTE: When measuring small values of resistance, the position of the KELVIN KLIPS® or sorting fixture contacts on the resistor leads can significantly affect the overall resistance measured by the ohmmeter. The length of resistor lead, L, between each clip and the resistor body has a resistance which will be measured by the ohmmeter as an integral part of the resistor. Care should be taken to ensure that incorrect readings do not occur due to improperly chosen lengths, L.



For a continuous reading on a resistor, set the pushbutton control as follows:

POWER ON (lighted)

RANGE — Model 1701B: Select proper range (range buttons are interlocked; if none are in, the 2Ω range is selected).

Model 1705B: The button should be out for autoranging. If pressed in (HOLD), the unit will remain on a particular range.

CYCLE HOLD — Model 1701B: Out (if the button is in, push to release).

or

CYCLE SINGLE — Model 1705B: Out (if the button is in, push to release).

CYCLE START — Press if converter was halted by HOLD button.

RATE — In for fast; out for slow.

GEN/DC — Model 1701B: In for inductive unknowns; out for non-inductive unknowns (see Section 4.2).

When moving from one resistor to another the display will overload, subsequently blanking the display except for sign and decimal point. This does not damage the preamplifier or cause any recovery time delay.

For a single reading on a resistor, set the pushbuttons as before except push in CYCLE HOLD (Model 1701B) or CYCLE SINGLE (Model 1705B) and press the START button for each reading.

2.4 REMOTE OPERATION

2.4.1 Measurement Rate

Signal SB, appearing on rear-panel connector J1 pin 37, is normally high and pulses low to start a measurement. To remotely control the measurement rate, an overriding signal must be supplied to hold SB low. Then, to start each measurement, pulse this signal high (the trailing edge of the pulse starts the measurement). The only restriction on a signal applied to SB is that is should be "clean". If the signal is from switch contacts, it should be buffered to prevent switch bounce from restarting the converter. At the end of each measurement, pulse F occurs, and appears on rear-panel connector J1 pin 29. This pulse may be used to detect end-of-converstion. It can also be delayed if desired, and used to generate the SB override signal. Pulse F goes high for 4ms except with the Model 1705B when it goes high for 10µs.

2.4.2 Single Cycle - Continuous Operation

To remotely return to continuous operation, hold signal SB (J1 pin 37) low, pulse it, then let it go high. This will cause it to start and allow it to continue after each measurement. An open collector gate or a passive pull-up gate should be used.

To remain in single cycle operation, signal SB is held high and pulsed low. The CYCLE button must be in the SINGLE position (pushed in).

2.4.3 Remote Start

When the CYCLE button is set out for continuous operation (after stopping by going to SINGLE), the SB signal will restart the unit when it is pulsed low. See Section 2.3.1.

2.4.4 Autoranging

The four range bit lines appearing at rear-panel connector J1 pins 19, 20, 21 and 22 are used to either sense the auto selected range, or to set the range, depending upon which way the R/A (Remote/Automatic Ranging) line (J1 pin 18) is set.

In the autoranging mode, the R/A line is allowed to go high, and the four range bit lines have BCD information for the range selected (see Table 2-1). These lines must be allowed to float to permit correct ranging.

To remotely program the range, the R/A line is held low. The range can now be selected by setting the appropriate range lines low according to Table 2-1.

RANGE	FULL SCALE	J1 PIN 19 BIT 1	PIN 20 BIT 2	PIN 22 BIT 8	PIN 21 BIT 4
1	200mΩ	Ø	1	1	1
2	2Ω	1	Ø	1	1
3	20Ω	Ø	Ø	1	1
4	200Ω	1	1	Ø	1
5	2kΩ	Ø	1	Ø	1
6	20kΩ	1	Ø	Ø	1
7	200kΩ	Ø	Ø	Ø	1
8	2MΩ	1	1	1	Ø
9	20MΩ	Ø	1	1	Ø

Low = Ø = ØV
High = 1 = 5V

Table 2-1. Model 1705B Range Sensing or Setting Bits

NOTES FOR TABLE 2-2

Digit 5 is the most significant digit.
Digit 1 is the least significant digit.

INVERTED BCD OUTPUTS ONLY - All buffered outputs are open collector Ø true. When read lines are low (Ø), all outputs will be floating (no pull-ups) or 1 (pull-up). Read lines must be pulled high (1) to read data. This allows data to be read out 19 bits at a time by tying all read lines together and using separate data lines; or 4 bits at a time, using the same four data lines and separate read lines.

NON INVERTED BCD OUTPUTS (SP 3796) - Optional non-inverted outputs are TTL 1=true; when read lines are low, all outputs are pulled low. Outputs are not open collector and require no pull-ups. Read lines must be pulled high (1) to read data. Separate data lines and separate read lines are required to read data out simultaneously, or 4 bits at a time.

See Section 4.3 to change output logic.

PINS		FUNCTION
1	C2*	Digit 2, BCD bit 4,Ø = true
2	B2*	Digit 2, BCD bit 2,Ø = true
3,4,17		Spare
5 thru 16	Ø volts	GD (logic return)
18	R/A	Remote or Autoranging (1705B only) 1 = Autoranging
19	(1)	Range sensing/selecting bit 1 (1705B only) Ø = true
20	(2)	Range sensing/selecting bit 2 (1705B only) Ø = true
21	(8)	Range sensing/selecting bit 8 (1705B only) Ø = true
22	(4)	Range sensing/selecting bit 4 (1705B only) Ø = true
23,24,25		Decimal points 3, 2 and 1 respectively (Ø = true or decimal point on)
26	RD	Digit 2 read signal, 1 = read
27	D2*	Digit 2, BCD bit 8,Ø = true
29	F	Final conversion complete, normally = Ø, goes high for 4ms (10µs if using Model 1705B) at end of measurement. Will drive 6 TTL loads. Data has been updated just prior to this signal.
28	A2*	Digit 2, BCD bit, 1,Ø = true
30	+*	Digit 5, + sign, Ø = +
31	RA	Digit 5 read signal, 1 = read
33	S2	Chopper control signal, will drive 5 TTL loads
32	A5*	Digit 5, BCD bit 1,Ø = true
34	*	Digit 5, overload bit, Ø = overload ( )
35	B4*	Digit 4, BCD bit 2,Ø = true
36	A4*	Digit 4, BCD bit 1,Ø = true
37	SB	Start signal, normally = 1, transition from 1 to Ø starts measurement, Ø inhibits continuous mode of measurement
38	RB	Digit 4 read signal, 1 = read
39	C4*	Digit 4, BCD bit 4,Ø = true
40	D4*	Digit 4, BCD bit 8,Ø = true
41	B3*	Digit 3, BCD bit 2,Ø = true
42	A3*	Digit 3, BCD bit 1,Ø = true
43	RC	Digit 3 read signal, 1 = read
44	C3*	Digit 3, BCD bit 4,Ø = true
45	D3*	Digit 3, BCD bit 8,Ø = true
46	B1*	Digit 1, BCD bit 2,Ø = true
47	C1*	Digit 1, BCD bit 4,Ø = true
48	RE	Digit 1 read signal, 1 = read
49	D1*	Digit 1, BCD bit 8,Ø = true
50	A1*	Digit 1, BCD bit 1,Ø = true

Table 2-2. Remote Input/Output Connector J1 Pin Assignments

*If BCD (non-inverting) output option is selected, 1 = true on these outputs.

SECTION 3
CIRCUIT DESCRIPTIONS

3.1 SIMPLIFIED BLOCK DESCRIPTION

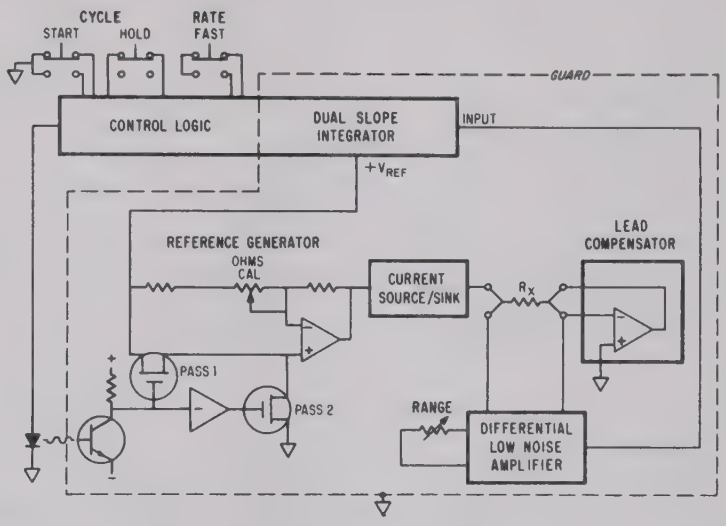


Figure 3-1. 1700 Series Simplified Diagram

A standard reference current is applied to the unknown resistor. The voltage across the unknown is amplified by the differential low-noise amplifier. The output of this amplifier is equal to the reference current times the unknown resistor times the gain of the amplifier. This output is biased negative and applied to the input of the dual slope integrator for a period of 1/60 second which will cause the integrator to go positive in a ramp.

At the end of 1/60 second the control logic switches from this input voltage to a reference voltage of the opposite polarity. This reference voltage causes the integrator to ramp toward zero at a known rate. The time it takes to reach zero is measured by counting clock pulses which are then stored in the counter.

On the second pass, the reference current is reversed and the process is repeated. Since the polarity was changed, the clock pulses on the second pass are subtracted from those of the first pass. The resulting BCD output is loaded into storage registers which feed the display. This data is stored until replaced at the end of each second conversion. The same storage registers that feed the display also feed the buffered outputs for the rear-panel connector.

By using a two-pass technique, offset voltages that stay constant regardless of polarity are cancelled. This includes thermal electrical offsets in the leads up to and including the unknown resistor, offsets associated with the differential low-noise amplifier, current source, lead compensator, reference generator, or offsets in the integrator section itself.

The RATE button, when pressed in, allows a settling time of 17ms (8, 33, 67, or 133ms optional) between application of current to the unknown and measurement of the voltage across the unknown. When the RATE button is out (push to release), the settling time is 267ms (133, 533, or 2133ms optional). See Section 4.2 to change settling times.

3.2 MODULE DESCRIPTIONS

The 1700-Series Digital Resistance Measuring System utilizes modular construction. The modules are: (1) Connector Board Assembly, (2) Transformer and Fan Assembly, (3) Power Supply Board, (4) Display Board, (5) Digital Converter Board, and (6) Preamplifier Board.

3.2.1 Connector Board

This board supplies all interconnections between the digital converter, preamplifier and power supply boards and to the remote input/output connector. It is mounted to the back panel along with the fuse, line cord receptacle, 5-volt power supply pass transistor and power wiring cables.

3.2.2 Transformer and Fan Assembly

This assembly contains the fan to cool the cabinet and the 50/60Hz, 110/220V transformer for the power supply. The assembly has two connectors for the AC and power supply cables.

3.2.3 Power Supply Board

This board contains a ±15V regulator. The 5V IC regulator is mounted on the back panel. The ±15V regulator uses two IC regulators that are internally short-circuit and thermal-overload protected. If these regulators are severely overloaded, they will cycle off until the overload is removed. The ±15V supply is floating while the +5V supply is tied to the AC and chassis ground.

3.2.4 Display Board

This assembly plugs into the digital converter board. It takes the stored results from the last measurement and displays it via 5-digit LED display. The maximum reading is ±19999. Decimal point positioning is determined by switch settings on the preamp board.

3.2.5 Digital Converter Board

This board contains a dual-slope integrating, auto-zeroing converter and the necessary control logic for it.

3.2.6 Preamplifier Assembly

This board includes all front-panel controls except the POWER switch, and the circuitry for the reference generator, unknown terminals, lead compensator, current source/sink, and differential low-noise amplifier.

SECTION 4
MAINTENANCE

WARNING

DANGEROUS VOLTAGE POTENTIALS EXIST INSIDE THIS INSTRUMENT. MAINTENANCE INSTRUCTIONS WITHIN THIS MANUAL ARE FOR USE BY QUALIFIED SERVICE PERSONNEL ONLY. TO AVOID ELECTRICAL SHOCK, DO NOT ATTEMPT ANY SERVICING OTHER THAN THAN CONTAINED IN THE OPERATION INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

4.1 CHANGING PREAMPLIFIER BOARDS

The preamplifier board of the 1700-Series Resistance Measuring System, although not intended to be routinely changed, may be replaced when a different set of ranges or characteristics is desired. To replace the board:

1. Remove the two screws securing the lower section of the front panel, and remove this panel strip.

2. Remove the preamplifier circuit board by pulling straight out. Be careful not to damage the board or its components.

3. Insert the new board, making sure that it is seated in the connector properly.

4. Install the correct front panel strip, using the screws removed in Step 1.

5. Calibrate preamplifier (refer to Section 4.5).

4.2 CHANGING SETTLING TIMES

The digital converter circuit board includes a feature that makes it possible to change the settling time if necessary.* The settling time is a built-in delay between when current is applied to the unknown and when the voltage across it is measured. The board is normally wired for the second fastest settling time. When resistors include a large amount of inductance, the minimum recommended settling time is approximately:

$$10 \frac{L}{R} \text{ Seconds}$$

where L is in henries and R is in ohms. Also, the ratio L/R should always be less than Ø.1.

The maximum advisable settling time is about one second.

The time is set by a jumper on the digital converter board near U23 and U24 as follows:

POINT X CONNECTED TO	SLOW RATE		FAST RATE	
	6ØHz	5ØHz	6ØHz	5ØHz
A	133	16Ø	8.3	1Ø
B	267	32Ø	16.7	2Ø
C	533	64Ø	33.4	4Ø
D	1Ø67	128Ø	67	8Ø
E	2133	256Ø	133	16Ø

Table 4-1. Settling Time in Milliseconds

The settling time (S.T.) affects the cycle time as follows:

cycle time (ms) $\approx$ 2(S.T.) + 47ms for 6ØHz
or 2(S.T.) + 54ms for 5ØHz
} For S.T. greater than 16.7 (6ØHz) or 2Ø (5ØHz)

The minimum display time is about 7Øms.

*Early instruments, designated SP 37XX, did not have this feature.

4.3 CHANGING OUTPUT LOGIC

Although the 1700-Series System is normally supplied with inverted output logic (0=True), provision has been made for changing to non-inverted logic (+5V=True).*

With inverted output logic, since the IC's are open collector types, the output lines can be bussed together and the enable lines strobed serially. With non-inverted logic, the outputs are not open collector and cannot be bussed although the enable lines can be strobed serially if desired.

If inverted logic is installed U35 through U39 on the digital converter circuit board will be type 7438 devices. With non-inverting logic (SP 3796), U35 through U39 are type 7408 devices. To change from one type of logic to the other, simply remove these devices from their sockets and replace with the appropriate type (see digital converter board layout for locations).

*Early instruments, designated SP 37XX, did not have this feature.

4.4 CHANGING POWER LINE FREQUENCY

Contained on the digital converter circuit board is a crystal-controlled oscillator that controls the integration time of the voltage across the unknown. This integration time is one cycle of the line-voltage frequency in order to provide best line-voltage rejection. For 60Hz countries the crystal installed is 1.96608MHz; for 50Hz countries it is 1.6384MHz. This crystal must be changed if the instrument is to be operated on a different line frequency than originally intended.

4.5 CALIBRATION

4.5.1 Model 1701B

The instrument should be warmed up for at least 15 minutes before making adjustments. A trimmer adjust tool is required plus a 1 ohm or 10 ohm standard resistor. All connections to the standard resistor shall be made using ESI KELVIN KLIPS®.

1. Remove Panel and Locate Adjustment Trimmers

   For access to adjustment trimmers, remove the two screws securing the lower section of the front panel and remove the panel strip. On left side of the exposed circuit board locate two trimmers with adjustment screws. They are to the left of J8. From left to right these adjustments are identified as:

   a) R6 AC Full Scale adjustment
   b) R61 DC Full Scale adjustment

   NOTE: Controls may interact. Recheck all settings after manual adjustments. When calibrating in the low ranges, unit may fluctuate ±1 digit due to external noise interference.

2. Adjust DC Full Scale (R61)

   Select DC mode. GEN push switch in the DC position (pushed in). Connect the standard resistor to the input. If reading is not within accuracy specifications, adjustment of R61 is indicated. Adjust R61 for the proper reading. This adjustment may affect setting of R6.

3. Adjust AC Full Scale (R6)

Select AC mode. GEN push switch in the out position (push to release). Connect the standard resistor to the input. If reading is not within accuracy specifications, adjustment of R6 is indicated. Adjust R6 for the proper reading. This adjustment may affect setting of R61.

4.5.2 Model 1705B

The instrument should be warmed up for at least 15 minutes before making adjustments. A trimmer adjust tool is required plus 100 milliohm, 100 ohm, 1000 ohm, and 1 megohm standard resistors. All connections to the standard resistors shall be made using ESI KELVIN KLIPS®.

1. Determine There are no Unbalances Between Ranges

Select DC mode. Connect unit to 100 ohm standard resistor and note reading. Disconnect 100 ohm standard. Connect unit to 1000 ohm standard resistor. Except for decimal point, second reading should be close to first reading. If this is the case, go to step 2. If readings vary more than four or five digits from each other, readjustment of Adjust Balance (R100) is indicated. This procedure is described in step 7.

2. Remove Panel and Locate Adjustment Trimmers

For access to adjustment trimmers, remove the two screws securing the lower section of the front panel and remove the panel strip. On the left side of the exposed circuit board locate a cluster of four trimmers with adjustment screws. From left to right these adjustments are identified as:

a) R94 AC Full Scale adjustment
b) R95 DC Full Scale adjustment
c) R97 DC Low Ohm adjustment
d) R96 DC High Ohm adjustment

NOTE: Controls may interact. Recheck all settings after manual adjustments. This is an autorange unit. When calibrating in the low ranges, unit may fluctuate ±1 digit due to external noise interference.

3. Adjust DC Full Scale (R95)

Select DC mode. Connect 1000 ohm standard resistor to input. If reading is not within accuracy specifications, readjustment of R95 is indicated. Adjust R95 for a reading of 1.0000 kilohm. This adjustment may affect setting of R94.

4. Adjust AC Full Scale (R94)

Select AC mode. Connect 1000 ohm standard resistor to input. If reading is not within accuracy specifications, readjustment of R94 is indicated. Adjust trimmer R94 for a reading of 1.0000 kilohm. This adjustment may affect setting of R95.

5. Adjust DC Low Ohm (R97)

Select DC mode. Connect 100 milliohm standard resistor to input. If reading is not within accuracy specification, readjustment of R97 is indicated. Adjust R97 for a reading of 100.00 milliohm.

6. Adjust DC High Ohm (R96)

Select DC continuous mode. Connect 1 megohm standard resistor to input. If reading is not within accuracy specifications, readjustment of R96 is indicated. Adjust R96 for a reading of 1.0000 megohm.

7. Adjust Balance (R100)

NOTE: This trimmer is factory adjusted and should not require readjustment under normal conditions of operation. A plug-in extender is required for this adjustment. (Reference ESI Part Number 27785.)

Remove panel as described in step 2. Pull out bottom circuit board, insert plug in extender between board and socket. Locate R100 trimmer on left side rear of board. Connect 100 ohm standard resistor to input and note reading. Remove 100 ohm resistor. Connect 1000 ohm standard resistor to input. Adjust R100 for same reading.

SECTION 5

PARTS LISTS AND DIAGRAMS

5.1 MODEL 1700 DIGITAL CONVERTER

5.1.1 Mainframe (Part No. 31700)

DESCRIPTION	ESI PART NO.	SCHEMATIC DIAGRAM PAGE NO.
Assembly, Rear Panel (Includes 27811)	27836	5-9
Assembly, Transformer and Fan Mounting Plate	27835	5-9
Bail	13174	
Bezel, Display (plastic filter)	27794	
Bezel, Front Panel	43883	
Bottom, Cabinet	27791	
Cable Assembly, KELVIN KLIPS®	27838	
Circuit Assembly, Power Supply	41889	5-9
Circuit Assembly, Digital Converter	27809	5-5
Circuit Assembly, Connector Board	27811	5-11
Circuit Assembly, Digital Display	27834	5-7
Connector Plug, 50 Pin	20297	
Foot, Rubber	08715	
Front Panel	27789	
Line Cord	44363	
Mounting Plate, Printed Circuit Board	27790	
Side, Cabinet	26030	
Top Cover	27792	

Options:

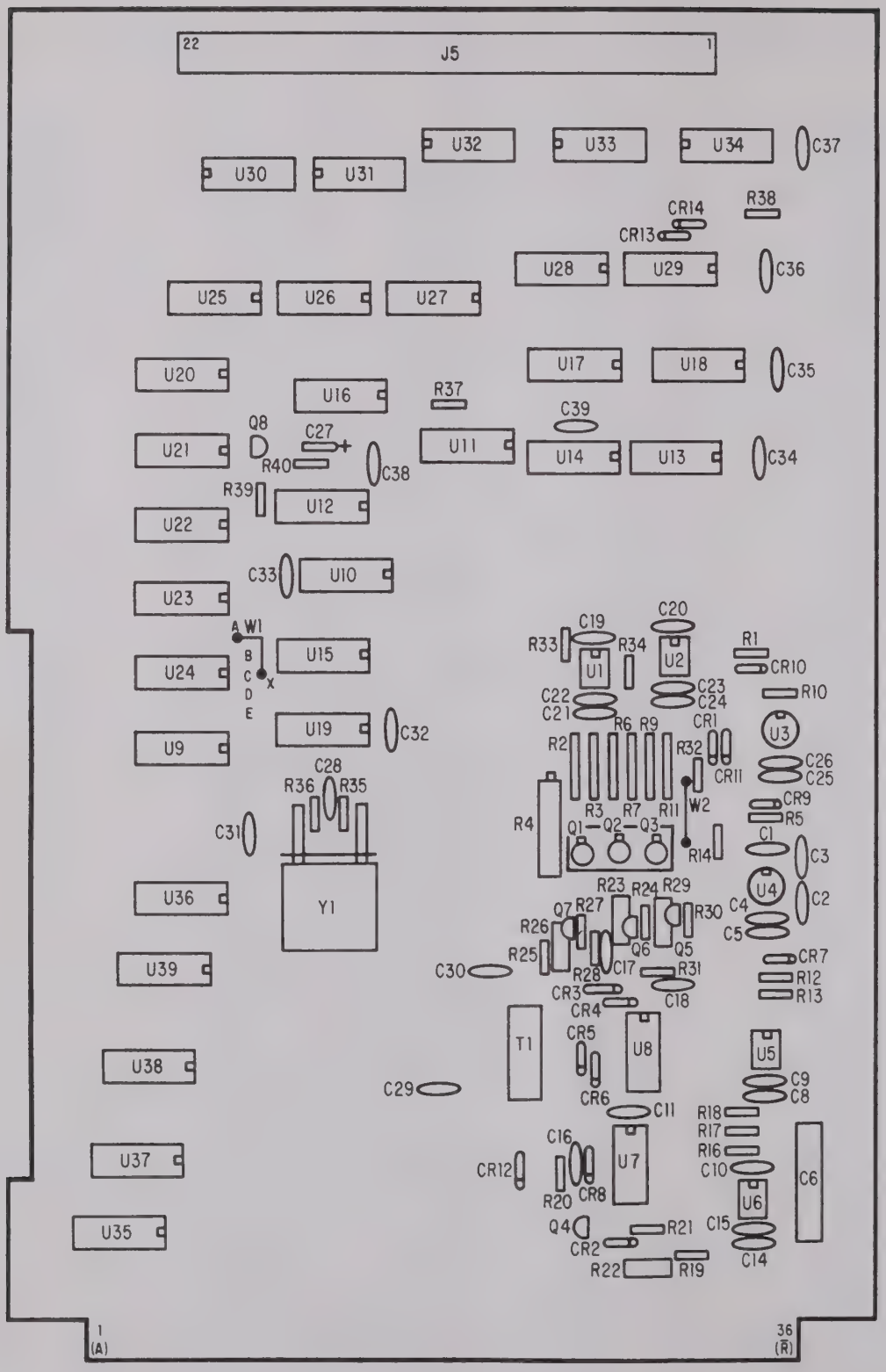
Cable Assembly, Spade Lug	27867
Cable Assembly, Unterminated	27842
Front Panel, Rack Mounting, Single	26341
Front Panel, Rack Mounting, Double	26342

5.1.2 Model 1700 Digital Converter Board (Part No. 27809)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
C1, C19, C20	Capacitor, 500pF, 30V	12043
C2, C39	Capacitor, 2000pF, 30V	21214
C3, C11	Capacitor, 1000pF, 30V	21215
C4, C5, C8, C9, C14, C15, C21-26, C29-C38	Capacitor, 0.01µF, 30V	12144
C6	Capacitor, 0.033µF, 200V	26097
C10	Capacitor, 30pF, 30V	20242
C16	Capacitor, 0.1µF, 30V	24395
C17, C18	Capacitor, 100pF, 30V	12241
C27	Capacitor, 3.3µF, 10V	25340
C28	Capacitor, 25pF, 10V	01924
CR1	Diode, Zener, 1N825	20868
CR2-CR7, CR11-CR14	Diode, 1N914	12356
CR8	Diode, Zener, 1N4733A	24555
CR9, CR10	Diode, Zener, 1N4742A	24556
J5	Connector, 44 Pin	27817
Q1-Q3	Transistor, MEM807	20675
Q4	Transistor, 2N3904	18751
Q5-Q7	Transistor, 2N3906	18754
Q8	Transistor, 2N3702	12041
R1, R5	Resistor, 1kΩ, 10%, 1/4W	13920
R2, R9	Resistor, 6kΩ, ESI Q	21108
R3	Resistor, 5.7kΩ, ESI Q	21109
R4	Resistor, 200Ω, Trimpot (10 Turn)	12083
R6	Resistor, 800Ω, ESI Q	21110
R7	Resistor, 16.9kΩ, 1%, Metal Film	25290
R10, R28, R31	Resistor, 3.3kΩ, 10%, 1/4W	13926
R11	Resistor, 10.98633kΩ, ESI Q	21111
R12	Resistor, 255kΩ, 1%, Metal Film	21228
R13, R17, R19, R39	Resistor, 10kΩ, 10%, 1/4W	13933
R14	Resistor, 4.7kΩ, 10%, 1/4W	13927
R16	Resistor, 2.2MΩ, 10%, 1/4W	13962
R18	Resistor, 33kΩ, 10%, 1/4W	13939
R20	Resistor, 6.8kΩ, 10%, 1/4W	13930
R21	Resistor, 3.9kΩ, 10%, 1/4W	13929
R22	Resistor, 220kΩ, 10%, 1/2W	02049
R23, R26, R29	Resistor, 1.8kΩ, 10%, 1/2W	09917
R24, R27, R30	Resistor, 680Ω, 10%, 1/4W	13917
R25	Resistor, 2.7kΩ, 10%, 1/4W	13925
R32, R38	Resistor, 470Ω, 10%, 1/4W	13915
R33	Resistor, 3.16kΩ, 1%, Metal Film	21735
R34	Resistor, 402Ω, 1%, Metal Film	21716
R35	Resistor, 560Ω, 10%, 1/4W	13916
R36	Resistor, 820Ω, 10%, 1/4W	13919
R37	Resistor, 150Ω, 10%, 1/4W	13909
R40	Resistor, 22kΩ, 10%, 1/4W	13937
T1	Pulse Transformer, PE-8309, 16 Pin DIP	21200

5.1.2 (Continued)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
U1, U2, U6	Op Amp, 301A	20669
U3	Op Amp, 741C	20668
U4	Op Amp, µ715	20639
U5	Op Amp, LH0042C	24554
U7, U8, U13, U18, U19	IC, 7400	20600
U9, U20-U24	IC, 7493	20617
U10, U14	IC, 7402	20602
U11	IC, 7420	20604
U12, U15, U16, U17	IC, 7473	20613
U25-U29	IC, SN74192	20681
U30-U34	IC, 7475	20614
U35-U39	IC, 7438 (Inverted Logic Output) or Option	20718
	IC, 7408 (Noninverted Logic Output)	20717
W1, W2	Jumper Wire, No. 20	-----
Y1	Crystal, 1.96608MHz (60Hz) or Option	27818
	Crystal, 1.6384MHz (50Hz)	27795
	Printed Circuit Board, Digital Converter	27808
	Socket, XTAL	24444
	Socket, 8 Pin, DIP for U1, U2	22410
	Socket, 14 Pin, DIP for U10-U16 and U35-U39	19189
	Socket, 16 Pin, DIP for Q1-Q3	20860


22
J5
1
U32
U33
U34
C37
U30
U31
CR14
R38
CR13
U28
U29
C36
U25
U26
U27
U17
U18
C35
U20
U16
R37
C39
Q8
C27
U11
U14
U13
C34
U21
R40
C38
R39
U12
U22
C33
U10
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A
W1
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C19
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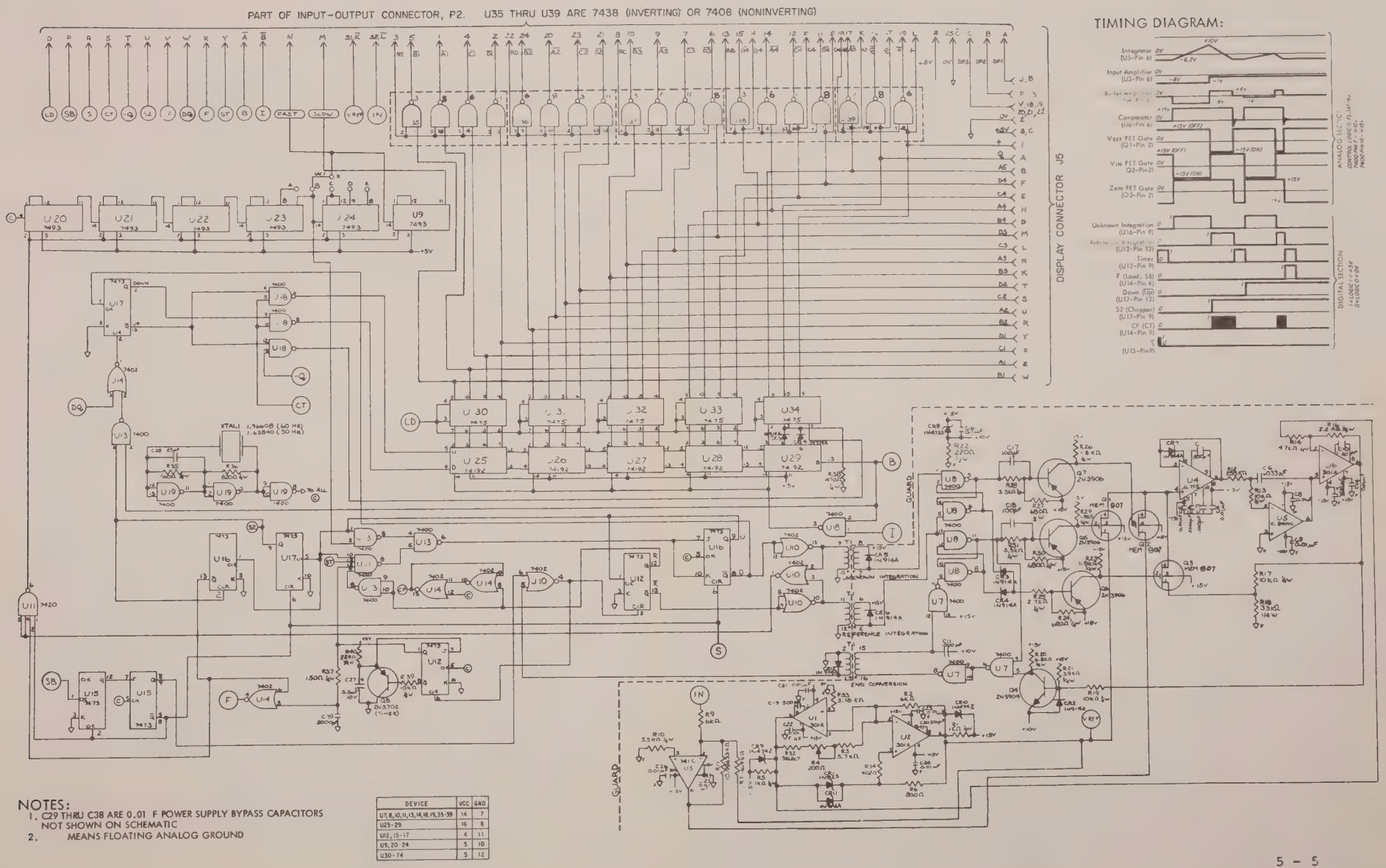
R33
R34
U1
U2
R1
CR10
U15
U24
C22
C21
C23
C24
R10
U19
C32
R6
R9
CR1
U3
U9
R2
R32
C26
C25
CR11
C28
R36
R35
R3
R7
R11
W2
CR9
R5
C31
R4
Q1
Q2
Q3
R14
C1
C3
U4
C2
R23
R24
R29
C4
U36
Y1
Q7
R27
R30
C5
R26
Q6
Q5
CR7
R25
C30
C17
R31
R28
R12
U39
CR3
C18
R13
CR4
T1
CR5
U8
U5
U38
C29
C9
C8
CR6
C11
R18
R17
C16
U7
R16
C10
C6
CR12
R20
CR8
U6
U37
Q4
R21
C15
CR2
C14
U35
R22
R19
1
(A)
36
(B)



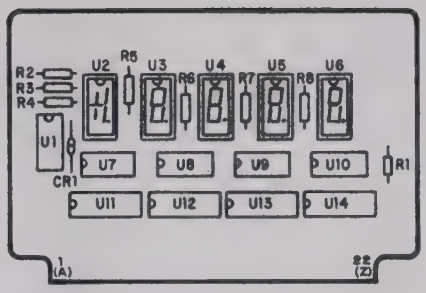
NOTES:
1. C29 THRU C38 ARE 0.01 F POWER SUPPLY BYPASS CAPACITORS NOT SHOWN ON SCHEMATIC
2. ⏚ MEANS FLOATING ANALOG GROUND

DEVICE	VCC	GND
U7, 8, 10, 11, 13, 14, 18, 19, 35-39	14	7
U25-29	16	8
U12, 15-17	4	11
U9, 20-24	5	10
U30-34	5	12

Figure 5-2. Model 1700 Digital Converter (ESI Part No. 27809)

5.1.3 Model 1700 Digital Display Circuit Assembly (Part No. 27834)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
CR1	Diode, 1N4005	01779
R1	Resistor, 1kΩ, 10%, 1/4W	13920
R2-R8	Resistor, 100Ω, 10%, 1/4W	13907
U1	IC, 7438	20718
U2	IC, MAN4630A, 7 Segment	41349
U3-U6	IC, MAN4610A, 7 Segment	41350
U7-U10	IC, 100Ω Resistor Network	20688
U11-U14	IC, 7447	20691
	Printed Circuit Board, Digital Display	27833
	Socket, 14 DIP for U2-U6	19189



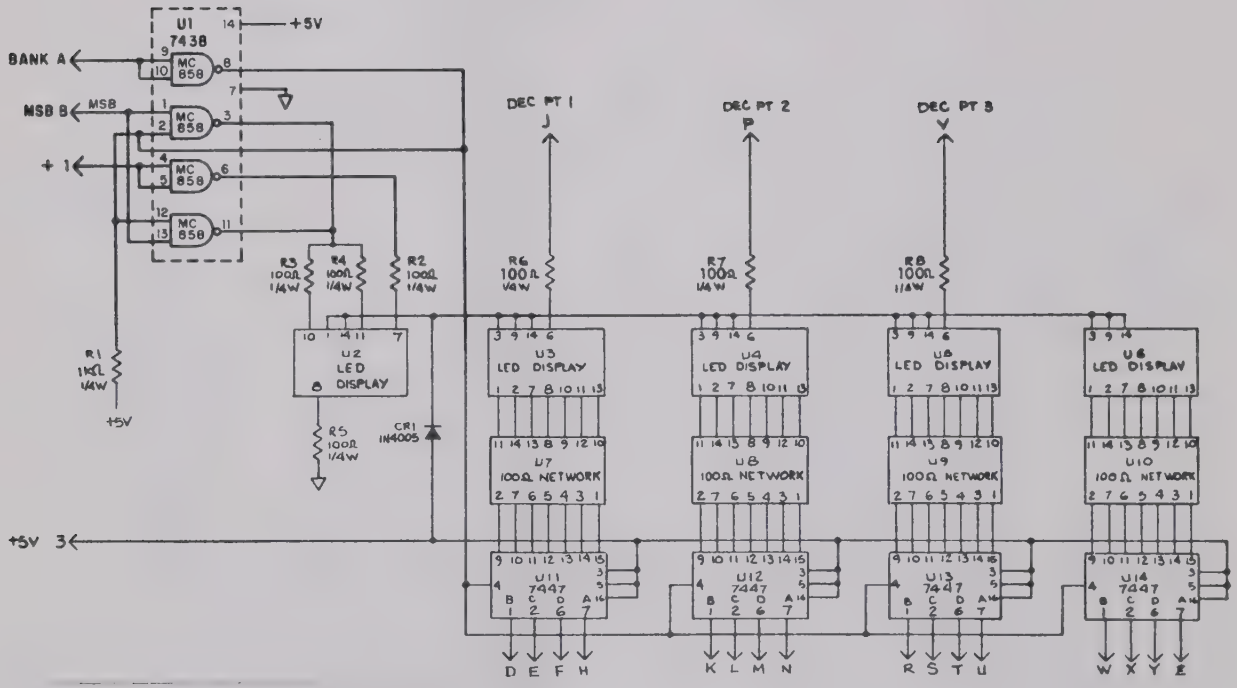


Figure 5-3. Model 1700 Digital Display Circuit Assembly (ESI Part No. 27834)

5.1.4 Model 1700 Power Supply Circuit Assembly (Part No. 41889)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
C1	Capacitor, 600µF, 15V	12123
C2	Capacitor, 8000µF, 15V	21216
C3, C9, C10	Capacitor, 0.1µF, 100V	24395
C4, C6	Capacitor, 500µF, 50V	01942
C5, C7	Capacitor, 50µF, 50V	12235
CR2, CR3	Full Wave Bridge, KBP-02	21236
CR4	Full Wave Bridge, MFB-200 MSC	27824
P6	Connector and Cable Assembly	27778
U1, U2	IC Voltage Regulator, 15V, µA7815	27816
W1, W2	Jumper Wire No. 20 Gold	-----
	Strain Relief, 9 Pin Connector	20517
	Printed Circuit Board, Power Supply	41890

5.1.5 Model 1700 Rear Panel Assembly (Part No. 27836)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
F1	Fuse, 1/2A, 3AG	01802
P7	Connector, 9 Pin	20505
R1	Resistor, 100kΩ, 10%, 1/4W	13945
S8	Switch, Pushbutton, POWER	18418
S9	Switch, Slide	18424
	Connector, Line Filter, 115/230V, 50-400Hz	20282
	Fuseholder	03074
	Rear Panel	43897
	Socket, Transistor	12262
	Voltage Regulator, LM323K, 5V	24010

5.1.6 Model 1700 Transformer and Fan Mounting Plate Assembly (Part No. 27835)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
J6, J7	Connector, 9 Pin	20506
	Fan	27829
	Mounting Plate	27787
	Transformer	27828

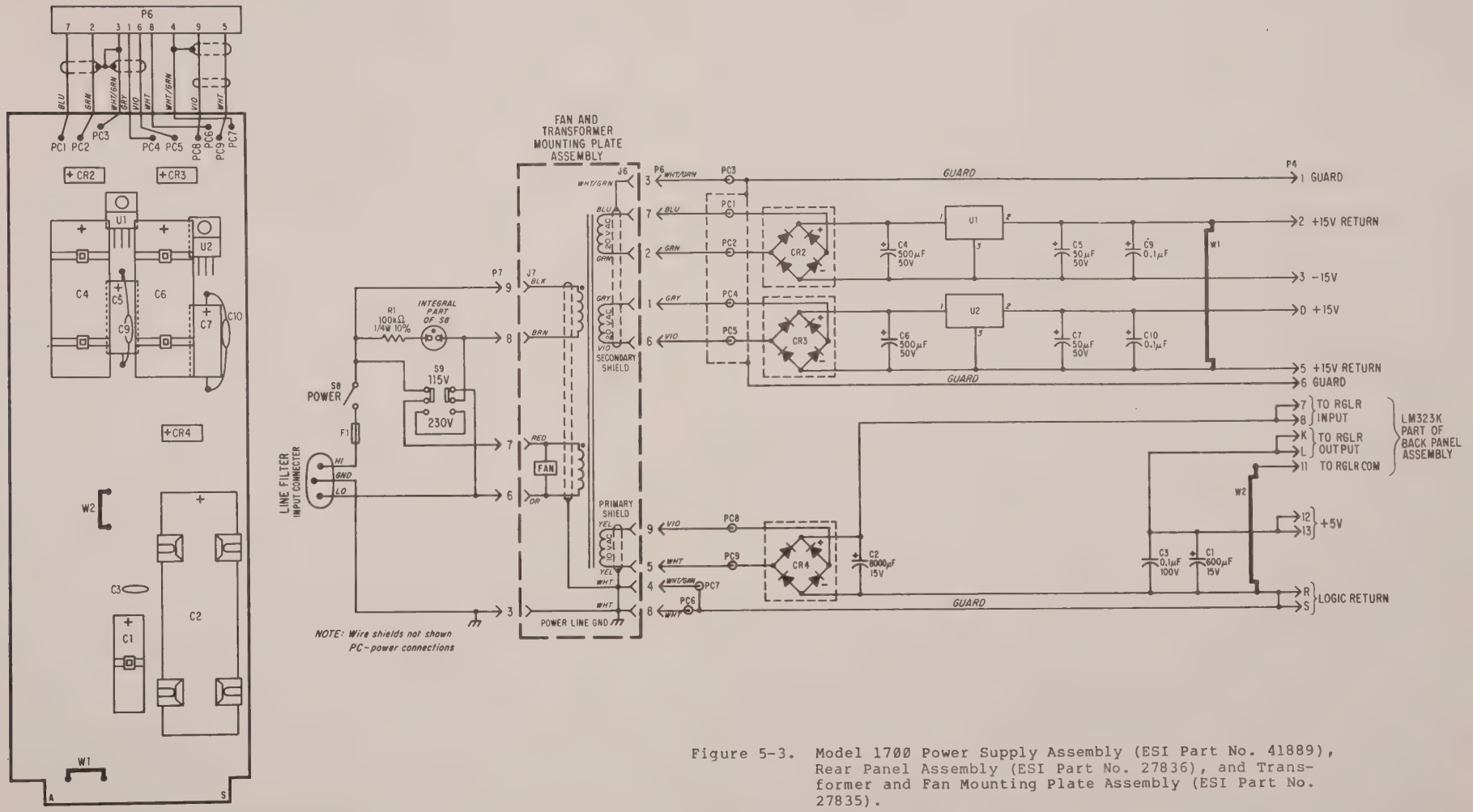


Figure 5-3. Model 1700 Power Supply Assembly (ESI Part No. 41889), Rear Panel Assembly (ESI Part No. 27836), and Transformer and Fan Mounting Plate Assembly (ESI Part No. 27835).

5.1.7 Model 1700 Connector Board Assembly (Part No. 27811)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
J1	Connector, 50 Pin	27815
J2, J3	Connector, 72 Pin	27821
J4	Connector, 30 Pin	27820
	Printed Circuit Board, Connector Board	27810

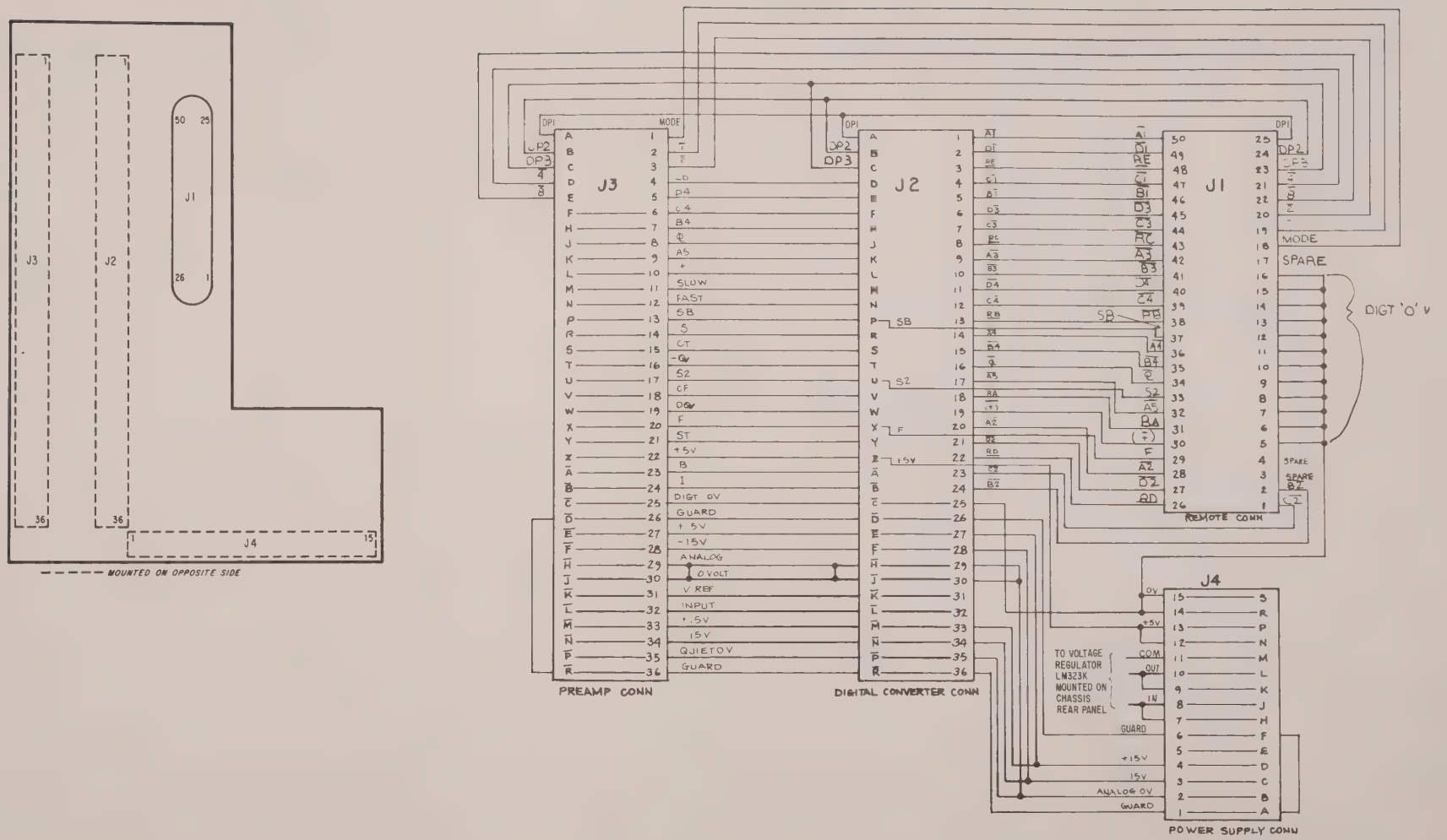


Figure 5-4. Model 1700 Connector Board (ESI Part No. 27811)

5.2 MODEL 1701B PREAMPLIFIER CIRCUIT ASSEMBLY (Part No. 41383) with Front Panel (41529)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
	Circuit Assembly, 1701B Preamp	41383
C1-C12, C15, C16, C19-C21, C31, C32	Capacitor, 0.01µF	12144
C13, C17	Capacitor, 100pF	12241
C22	Capacitor, 1000pF	21215
C30	Capacitor, 0.005µF	01919
CR3-CR6	Diode, MPD300	13639
CR7-CR12	Diode, 914A	12356
CR13	Diode, 1N4005	01779
DS1	Lamp, Neon, NE-2H	06468
J8	Connector, 9 Pin	20506
K1	Relay, DM2C	41517
Q1	Transistor, 3704	12077
Q2, Q3	Transistor, MEM807	20675
Q4, Q6	Transistor, 2N4921	18752
Q5, Q7	Transistor, 2N4918	18753
R1	Resistor, 470kΩ, 10%, 1/4W	13955
R2	Resistor, 47kΩ, 10%, 1/4W	13941
R3	Resistor, 22kΩ, 10%, 1/4W	13937
R4	Resistor, 220kΩ, 10%, 1/4W	13949
R5	Resistor, 4.95kΩ, ESI Q	22026
R6	Trimpot, 100Ω	26853
R7	Resistor, 2.7kΩ, 10%, 1/4W	13925
R8	Resistor, 150Ω, 10%, 1/4W	13909
R9	Resistor, 5kΩ, ESI QB	22027
R10, R11	Resistor, 6kΩ, ESI QB	22028
R12, R13, R19, R20	Resistor, 100Ω, 10%, 2W	12397
R14	Resistor, 500Ω, ESI QB	22029
R15	Resistor, 495.2Ω, ESI QB, 0.005%	22536
R16, R60	Resistor, 10Ω, ESI QB	22031
R17, R45, R47-R49	Resistor, 470Ω, 10%, 1/4W	13915
R18, R50	Resistor, 100Ω, 10%, 1/4W	13907
R33, R38	Resistor, 40kΩ, ESI F, 0.005%	22036
R34, R39, R43	Resistor, 9kΩ, ESI QB	22032
R35, R40	Resistor, 900Ω, ESI QB	22033
R36, R41	Resistor, 100Ω, ESI QB	22034
R37, R42	Resistor, Selected	-----
R44	Resistor, 1kΩ, ESI QB	22035
R46	Resistor, 4.7kΩ, 10%, 1/4W	13927
R51	Resistor, 2.2kΩ, 10%, 1/4W	13924
R52	Resistor, 1kΩ, 10%, 1/4W	13920
R61	Trimpot, 10kΩ	20145
R62	Resistor, 1MΩ, 10%	13960
S1-S7, S10	Switch, 8 Pushbutton	41518
U1-U5	IC 741	20668
U6, U7	IC LH0044	28187
U8	IC 7406	20678
U9	IC 846	20625
U10	IC 7473	20613

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
U11	Photo Coupled Pair MCT26	20674
W5-9	Wire Jumper, No. 28 Copper, Gold plate	-----
W10, W11	Wire Twisted Pair, Shielded	27812
	Connector, Mounting Block	27830
	Connector, Pins, Female Solder Type	20508
	Plate, Front Panel, Model 1701B	41528
	Printed Circuit Board, Preamplifier	41382
	Socket, 8 Pin, DIP for U6-U7	22410
	Socket, Pins, Female Solder Type	42814

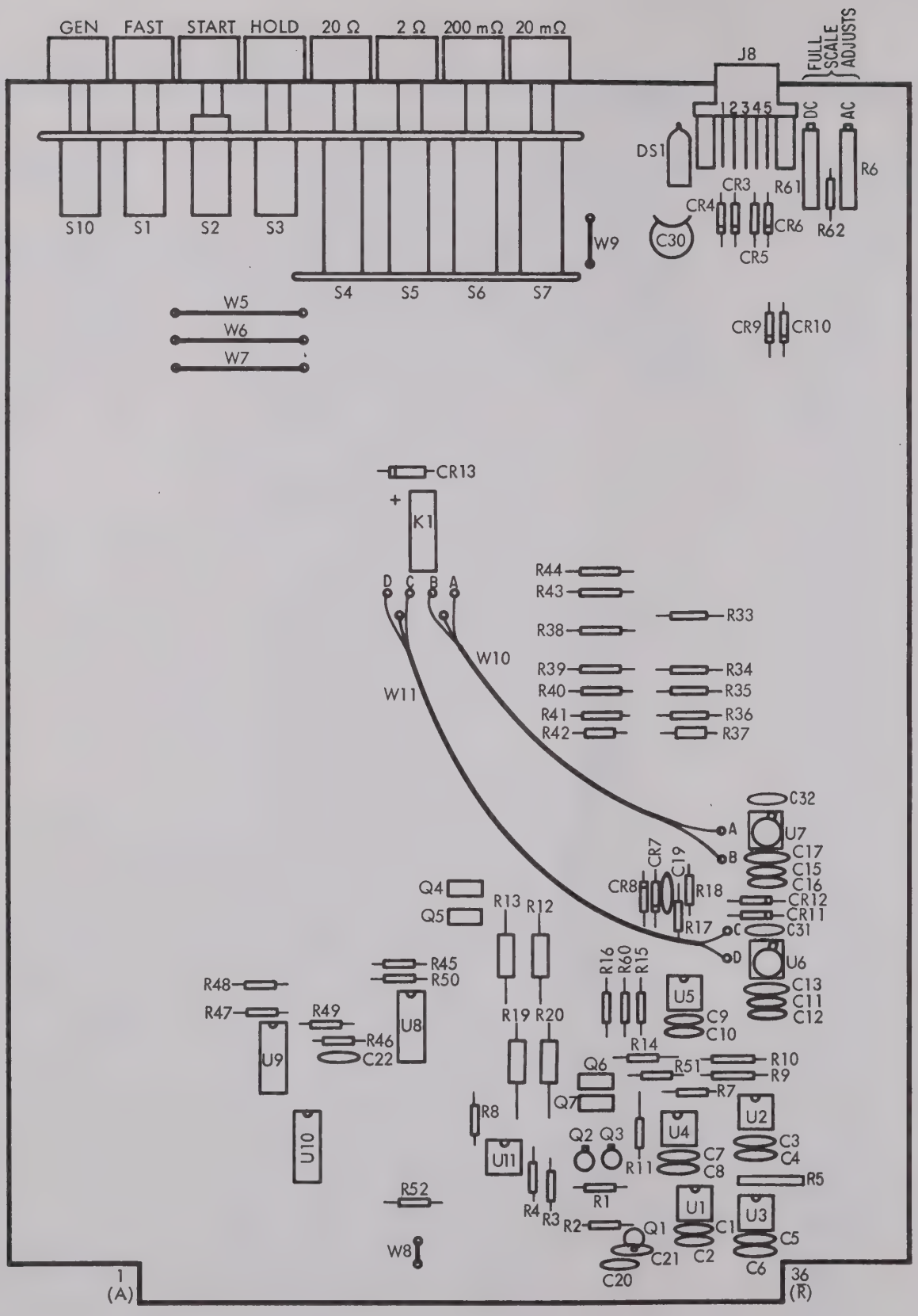
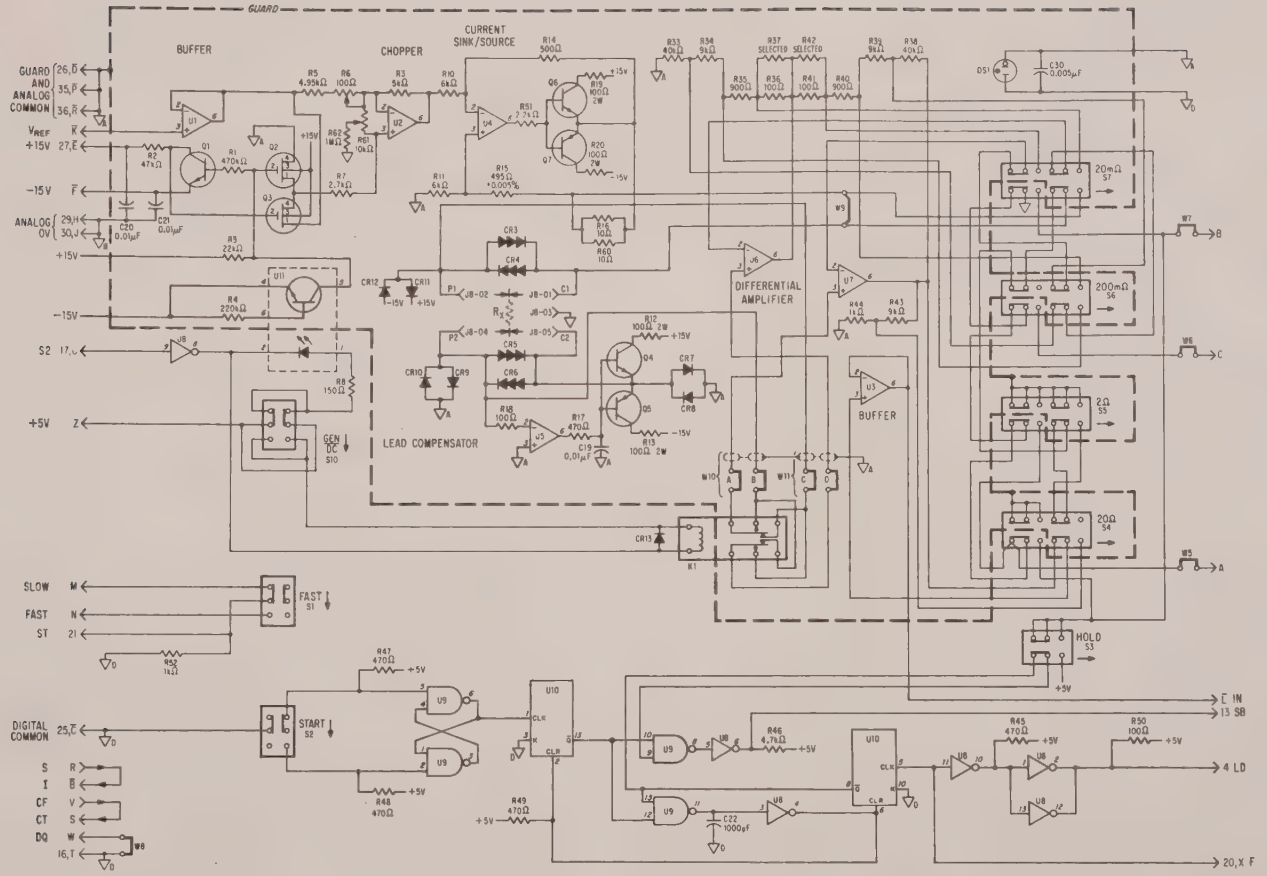
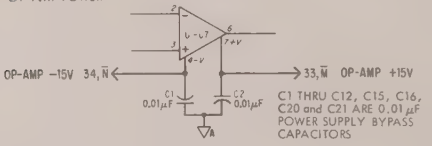


Figure 5-5. ESI Part No. 41383 Model 1701B
Parts Locations

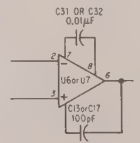


NOTES:

1. PUSH BUTTON SWITCHES S1 THRU S7 AND S10 SHOWN WITH BUTTON OUT
2. WHEN NO BUTTONS ARE DEPRESSED SWITCH 5 IS SELECTED
3. OP-AMP POWER



4. ALL CAPACITORS μF UNLESS NOTED
5. ALL RESISTORS 1/4 W, 10% UNLESS NOTED
6. FREQUENCY COMPENSATION



7. ▽A - ANALOG GROUND ▽D - DIGITAL GROUND

DEVICE	VCC	GND
U8	14	7
U9	14	7
U10	4	11

Figure 5-6. Model 1701B Preamplifier (ESI Part No. 41383)

5.3 MODEL 1705B AUTORANGING PREAMPLIFIER CIRCUIT ASSEMBLY (Part No. 31705)

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
C1-C23, C36, C37	Capacitor, 0.01µF, 100V, Ceramic	12144
C25-C28	Capacitor, 1500pF, 1kV, Disc	12117
C29	Capacitor, 0.1µF, 100V, Mylar	06470
C30	Capacitor, 100pF, 500V, Poly	18760
C31	Capacitor, 0.005µF, 1kV, Ceramic	01919
C32	Capacitor, 1000pF, 1kV, Ceramic	21215
C33	Capacitor, 25pF, 1kV, Ceramic	01924
C34	Capacitor, 0.47µF, 10V, Ceramic	20652
C35	Capacitor, 0.02µF, 100V	12115
C38	Capacitor, Selected $\leq$ 100pF	-----
CR1-CR10	Diode, IN914A	12356
CR11, CR12	Diode, MPD200	20876
CR13-CR16	Diode, MPD300	13639
CR17	Diode, IN4005	01779
DS1-DS4	LED, Red	26021
DS5	Lamp, Neon, NE-2H	06468
J8	Connector, 9 Pin Receptacle	20506
J11	Banana Jack, Black	02540
K1	Relay, GB835C 2E	27776
K2	Relay, DM2C	41517
K3	Relay, GB822A-2	26667
Q1-Q11	Transistor, FET, MEM807	20675
Q12	Transistor, FET, MEM575P	27777
Q13, Q14	Transistor, 2N4921	18752
Q15, Q16	Transistor, 2N4918	18753
Q17	Transistor, 2N3702	12041
Q18-Q23	Transistor, 2N3704	12077
R1	Resistor, 4.95kΩ, ESI QP 0.01%	22026
R2, R19	Resistor, 5kΩ, ESI QP 0.002%	20991
R3	Resistor, 4.2kΩ, ESI QP 0.002%	27988
R4	Resistor, 5.4kΩ, ESI QP 0.002%	27989
R5	Resistor, 1.6kΩ, ESI QP 0.002%	27990
R6, R10	Resistor, 20kΩ, ESI QP 0.002%	27992
R7	Resistor, 2.2216MΩ, ESI F 0.01%	27991
R8	Resistor, 680Ω, 10%, 1/4W	13917
R9, R24	Resistor, 9kΩ, ESI QP 0.002%	20986
R11	Resistor, 8.001kΩ, ESI QP 0.002%	27998
R12	Resistor, 934.730Ω, ESI QP 0.002%	27999
R13-R15	Resistor, 192.845Ω, ESI QP 0.002%	27983
R16	Resistor, Selected	-----
R17, R18	Resistor, 10kΩ, ESI QP 0.002%	41246
R20	Resistor, 15kΩ, ESI QP 0.002%	27997
R21	Resistor, 622.222Ω, ESI QP 0.002%	27982
R22	Resistor, 39.3778kΩ, ESI QP 0.002%	27981
R23	Resistor, 13.3333kΩ, ESI QP 0.002%	27980
R25	Resistor, 8.1kΩ, ESI QP 0.002%	27995
R26	Resistor, 1.9kΩ, ESI QP 0.002%	27994

CIRCUIT NO.	DESCRIPTION	ESI PART NO.
R27-R31	Resistor, 22kΩ, 10%, 1/4W	13937
R32-R36	Resistor, 470kΩ, 10%, 1/4W	13955
R37-R41	Resistor, 47kΩ, 10%, 1/4W	13941
R42-R46	Resistor, 220kΩ, 10%, 1/4W	13949
R48	Resistor, 680kΩ, 10%, 1/4W	19304
R49	Resistor, 2.7kΩ, 10%, 1/4W	13925
R50, R58, R90, R98	Resistor, 470Ω, 10%, 1/4W	13915
R51, R52	Resistor, 82Ω, 10%, 1/2W	06183
R53	Resistor, 10kΩ, 10%, 1/4W	13933
R54, R91	Resistor, 220Ω, 10%, 1/4W	13911
R56, R87	Resistor, 120Ω, 10%, 1/4W	13908
R57, R93	Resistor, 22MΩ, 10%, 1/4W	13978
R59, R60, R65	Resistor, 4.7kΩ, 10%, 1/4W	13927
R61, R62	Resistor, 150Ω, 10%, 2W	25691
R63, R64	Resistor, 2.7Ω, 10%, 1/4W	13887
R66-R70	Resistor, 150Ω, 10%, 1/4W	13909
R71-R74, R78-R85	Resistor, 5.6kΩ, 10%, 1/4W	13928
R75, R86, R88, R89	Resistor, 1kΩ, 10%, 1/4W	13920
R94	Trim Pot, 100Ω	26853
R95-R97	Trim Pot, 10kΩ	20145
R99	Resistor, 100kΩ, 10%, 1/4W	13945
R100	Trim Pot, 10kΩ	41902
S1	Switch, Push Button	42859
U1	IC, 7404	20695
U2, U7	IC, 7406	20678
U3	IC, 7442	20608
U4	IC, 74192	20681
U5, U8, U15	IC, 7438	20718
U6, U16	IC, 7475	20614
U9	IC, 7473	20613
U10	IC, 7402	20602
U11-U14, U17	IC, 7420	20604
U18	IC, 7400	20600
U19-U22	OP-AMP, 741	20668
U23-U26	OP-AMP, LH0044CH	28187
U27-U31	Opto-Isolator, 4N28	20674
W1	Wire, Twisted Pair, Shielded	27812
	Connector Mounting Block	27830
	Connector, Pins, Female Solder Type	20508
	Plate, Front Panel, Model 1705B	42867
	Printed Circuit Board, Preamplifier	42864
	Socket, 8 Pin, DIP for U27-U31	22410
	Socket, Pins, Female Solder Type	42814

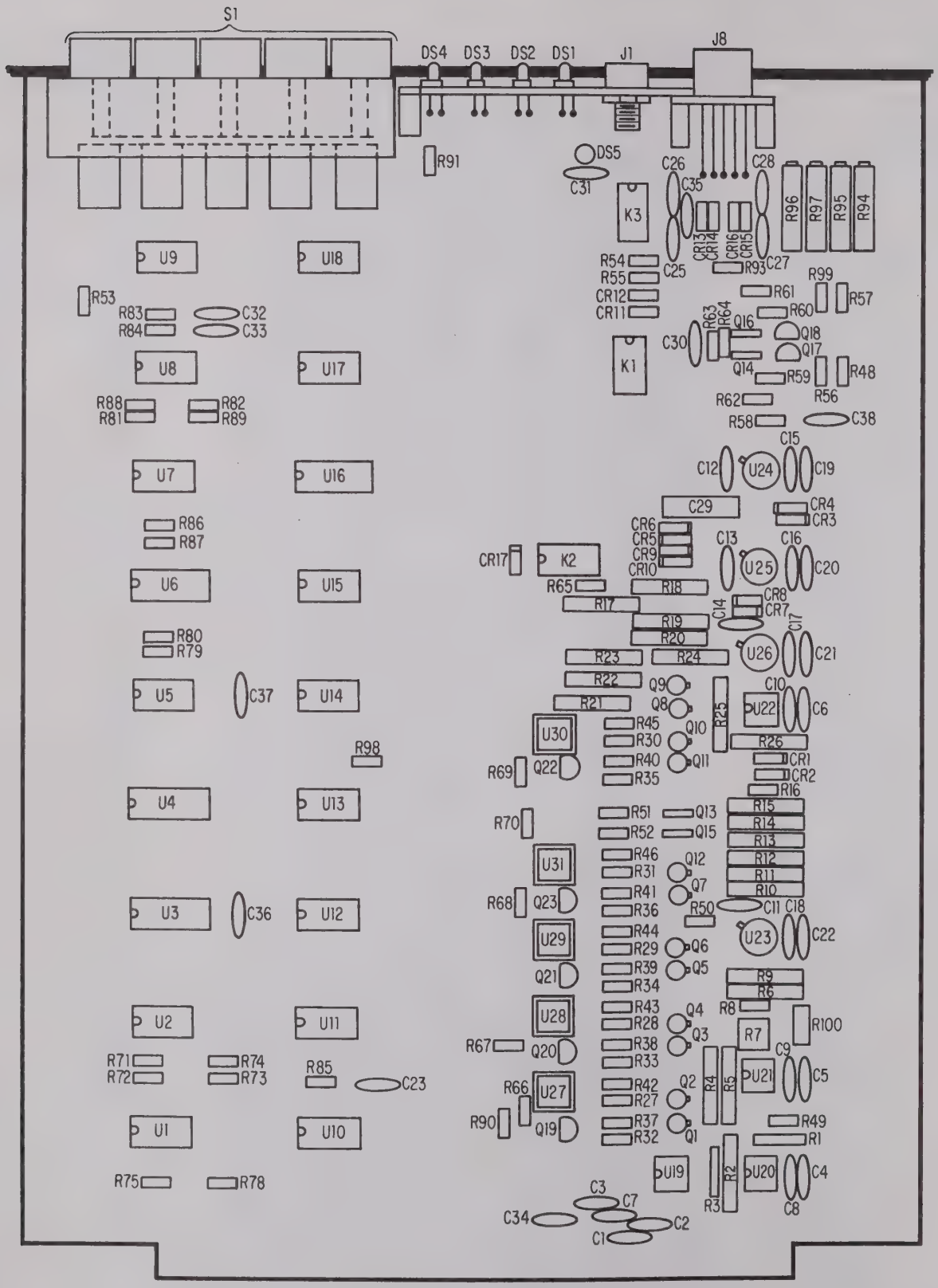
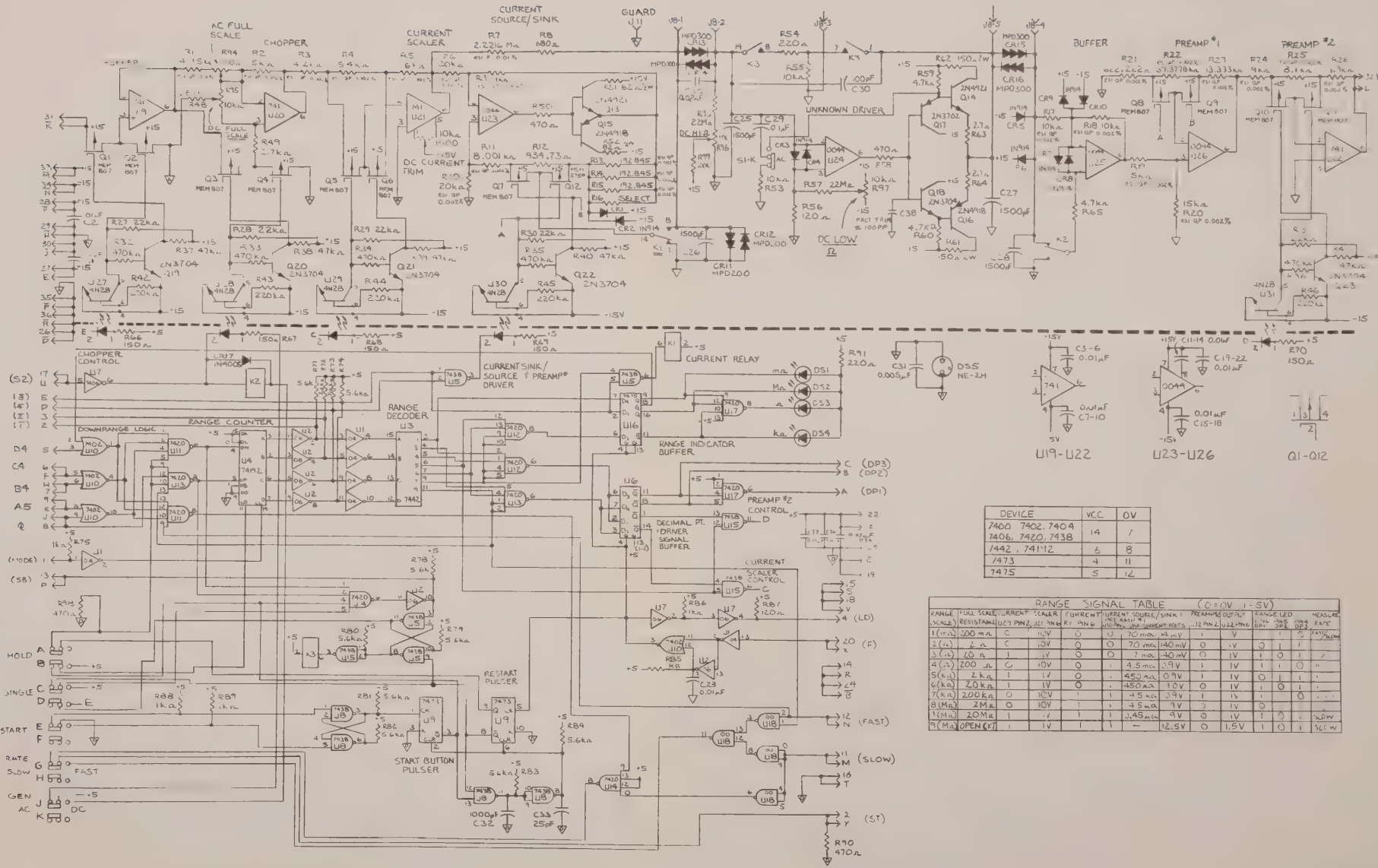


Figure 5-8. ESI Part No. 31705 Model 1705B, Parts Locations



DEVICE	VCC	0V
7400 7402 7404 7406, 7420, 7438	14	7
1442 ; 74192	6	8
7473	4	11
7475	5	12

RANGE SIGNAL TABLE (0=0V 1-5V)

RANGE (SCALE)	FULL SCALE RESISTANCE	CURRENT SCALER U29 PIN 2	CURRENT SCALER U21 PIN 6	CURRENT SCALER R7 PIN 6	CURRENT SOURCE/SINK (SEE ASSY # DIGITAL AND CURRENT RATES)	PREAMP OUTPUT ..12 PIN 2	PREAMP OUTPUT U22 PIN 6	RANGE LED 1 PIN DP1	RANGE LED 2 PIN DP2	RANGE LED 3 PIN DP3	MEASURE RATE
1 (mA)	200 mA	C	10V	0	0	70 mA 14 mV	1	V	0	1	FAST / SLOW
2 (Ω)	2 Ω	C	10V	0	0	70 mA 140 mV	0	1V	0	1	
3 (Ω)	20 Ω	1	1V	0	0	7 mA 140 mV	0	1V	1	0	1 /
4 (Ω)	200 Ω	C	10V	0	.	4.5 mA 0.9V	1	1V	1	0	1 "
5 (kΩ)	2 kΩ	1	1V	0	.	450 μA 0.9V	1	1V	0	1	1 .
6 (kΩ)	20 kΩ	1	1V	0	.	450 μA 10V	0	1V	.	0	1 .
7 (kΩ)	200 kΩ	0	10V	1	1	45 μA 9V	1	1V	.	0	. .
8 (MΩ)	2 MΩ	0	10V	1	1	4.5 μA 9V	0	1V	0	.	
9 (MΩ)	20 MΩ	1	1V	1	1	0.45 μA 9V	0	1V	1	0	1 SLOW
0 (MΩ)	OPEN CKT	1	1V	1	1	— 12.5V	0	1.5V	1	0	1 SLOW

Figure 5-9. Model 1705B Autoranging Preamplifier Circuit Assembly (ESI Part No. 31705)

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5. Did the manual contain the information you needed? ☐ YES ☐ NO
   If NO, what would you add _____
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